ing high bypass ratios by increasing fan section diameter will dramatically increase the nacelle aerodynamic force which increases with the square of fan section diameter, thereby increasing backbone bending. Thus, either method of increasing bypass ratio beyond that of present generation commercial engines (approximately five) will exacerbate backbone bending and fan case ovalization so much that mitigation of these effects by case and strut strengthening will impose an undesirable and possibly prohibitive weight increase.

Another detrimental aspect of conventional mounting arrangements is the drag created by the pylon in the fan flow stream, and particularly, in that portion of the fan flow stream downstream of the fan duct discharge plane. The fan flow is subsonic upstream of the fan duct discharge plane and supersonic downstream thereof. The drag associated with supersonic flow significantly exceeds that associated with subsonic flow for a given pylon surface area. In conventional mounting arrangements, the pylon has a large surface area, most of which is downstream of the fan duct discharge plane where its exposure to supersonic flow creates significant drag that detracts from aircraft operating efficiency.

In view of these shortcomings, an aircraft engine nacelle and mounting arrangement that isolates the engine from ovalization and backbone bending, contributes to engine efficiency retention, and minimizes engine weight and pylon drag is sought.

DISCLOSURE OF THE INVENTION

According to one aspect of the present invention the adverse effects of backbone bending and ovalization are significantly reduced by a unique nacelle and mounting arrangement that substantially isolates the engine from the nacelle aerodynamic force by transmitting that force directly from the nacelle to the aircraft.

At least a portion of the nacelle is united with an aircraft mounted pylon beam so that the load path for transmitting the nacelle aerodynamic force to the aircraft bypasses the engine and transfers the force directly from the nacelle to the pylon beam and the aircraft. A streamlined subpylon extends across the fan flow stream to transmit most other forces, for example engine weight and thrust, from the engine to the pylon beam. In one arrangement, the nacelle and pylon beam are individual components united by a separable joint located outside the region of juncture of the pylon beam and the subpylon. Because of the separable joint, the nacelle and pylon beam can be manufactured independently if it is desirable to do so. In addition, one or more partitioning joints may be located along the length of the pylon beam if desired. Because the engine is supported from the pylon beam by the subpylon, the partitioning joint can be used to detach the engine and nacelle from the aircraft as a complete unit. In another embodiment, the nacelle and pylon beam are united by being manufactured as a one piece integral unit or manufactured to act as a one piece integral unit.

According to another aspect of the invention, drag is reduced by locating the pylon beam radially outward of the fan flow stream and minimizing the surface area of the subpylon exposed to the supersonic flow downstream of the fan duct discharge plane. A significant contribution to the reduction of the subpylon size is made possible by reacting engine torque at a location forward of the conventional torque reaction location.

In one detailed arrangement of the nacelle components for suspending an engine under an aircraft wing, the nacelle includes an inlet, an intermediate cowl, a fan duct outer wall and a core cowl. The intermediate cowl is axially split into upper and lower segments to facilitate engine removal. The lower segment can be an essentially 180° segment removably secured to the upper segment, or can be a pair of subsegments hinged to the upper segment. In an alternative arrangement, the nacelle includes upper and lower fan cowls, a fan duct outer wall and a core cowl. The upper and lower fan cowls are each an essentially 180° segment.

The primary advantages of the invention are the engine efficiency retention and weight savings which result from isolating the engine from the adverse effects of fan case ovalization and backbone bending rather than mitigating those effects by strengthening the cases and fan struts.

Another advantage is the drag reduction resulting from locating the pylon beam radially outward of the fan flow stream and placing the torque reaction mount links at a location that contributes to minimizing the surface area of the subpylon skin exposed to supersonic flow.

Another advantage of the present invention is the unique arrangement of nacelle components that facilitates convenient removal and replacement of the engine without subjecting nacelle component interfaces to high stresses.

The foregoing features and advantages of the present invention will become more apparent in light of the following detailed description of the best mode for carrying out the invention and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross sectional elevation of the nacelle and mounting arrangement of the present invention as applied to a high bypass ratio ducted fan engine suspended under the wing of an aircraft;

FIG. **2** is a fragmentary perspective view of the nacelle and mounting arrangement of the present invention showing additional details;

FIG. **3** is a perspective view showing one arrangement of the nacelle components of the present invention;

FIG. **4** is a fragmentary perspective view illustrating an alternative interface between the lower and upper intermediate cowl segments of FIG. **3**;

FIG. **5** is a perspective view of the upper and lower intermediate cowl segments of FIG. **3** illustrating an alternative arrangement of the lower intermediate cowl segment;

FIG. **6** is a perspective view showing an alternative arrangement of the nacelle components of the present invention; and

FIG. **7** is a cross sectional elevation of a prior art nacelle and mounting arrangement for a high bypass ratio ducted fan engine.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring to FIGS. **1** and **2**, a high bypass ratio ducted fan aircraft engine **10** includes a core section **12** whose internal components (not shown) include one or more bladed axial flow compressors, driven by corresponding bladed axial flow turbines rotating about a longitudinal axis **14**. A core case **16**, essentially circular in cross section when viewed along the axis at any axial location, forms the outer flow path boundary of the core section and serves as a structural frame or backbone of the engine. Circumferentially extending blade tip seals (not shown) are positioned on the inner surface of the core case radially outward of the rotating